

7.5-Minute Digital Elevation Model (DEM)

Digital Elevation Model (DEM) is the terminology adopted by the USGS to describe terrain elevation data sets in a digital raster form. The 7.5-minute DEM (30- by 30-m data spacing, cast on a Universal Transverse Mercator (UTM) projection) provides coverage in 7.5- by 7.5-minute blocks. Each product provides the same coverage as a standard USGS 7.5-minute quadrangle without over edge. Coverage is for the contiguous United States, Hawaii, and Puerto Rico. This is a data-set level implementation of the Federal Geographic Data Committee's Content Standards for Digital Geospatial Metadata.

Information about individual 7.5-Minute DEM records can be obtained from the EROS Data Center.

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Identification Information

Identification_Information:

Citation:

Citation_Information:

- Originator: U.S. Geological Survey
- Publication_Date: 19790701
- Title: 7.5 minute Digital Elevation Models
- Geospatial_Data_Presentation_Form: map
- Publication_Information:
 - Publication_Place: Reston, VA
 - Publisher: U. S. Geological Survey

Description:

Abstract:

Digital Elevation Model (DEM) is the terminology adopted by the USGS to describe terrain elevation data sets in a digital raster form. The standard DEM consists of a regular array of elevations cast on a designated coordinate projection system. The DEM data are stored as a series of profiles in which the spacing of the elevations along and between each profile is in regular whole number intervals. The normal orientation of data is by columns and rows. Each column contains a series of elevations ordered from south to north with the order of the columns from west to east. The DEM is formatted as one ASCII header record (A- record), followed by a series of profile records (B- records) each of which include a short B-record header followed by a series of ASCII integer elevations per each profile. The last physical record of the DEM is an accuracy record (C-record).

7.5-minute DEM (30- by 30-m data spacing, cast on Universal Transverse Mercator (UTM) projection). Provides coverage in 7.5- by 7.5-minute blocks. Each product provides the same coverage as a standard USGS 7.5-minute quadrangle without over edge. Coverage is for the Contiguous United States, Hawaii, and Puerto Rico.

Purpose:

DEM's can be used as source data for digital orthophotos, and, as layers in geographic information systems, for earth science analysis. DEM's can also serve as tools for volumetric analysis, for site location of towers, or for drainage basin delineation. These data were collected as part of the National Mapping Program.

Supplemental_Information:

7.5-minute DEMs have rows and columns which vary in length and are staggered. The UTM bounding coordinates form a quadrilateral (no two sides are parallel to each other), rather than a rectangle. The user will need to pad out the uneven rows and columns with blanks or flagged data values, if a rectangle is required for the user's application. Some software vendors have incorporated this function into their software for input of standard formatted USGS DEMs.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19790701

Ending_Date: Present

Currentness_Reference: ground condition

Status:

Progress: In work

Maintenance_and_Update_Frequency: Irregular

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -124.7333

East_Bounding_Coordinate: -067.9500

North_Bounding_Coordinate: 49.3833

South_Bounding_Coordinate: 24.5333

Keywords:

Theme:

Theme_Keyword_Thesaurus: none

Theme_Keyword: DEM

Theme_Keyword: digital elevation model

Theme_Keyword: digital terrain model

Theme_Keyword: hypsography

Theme_Keyword: altitude

Theme_Keyword: height

Theme_Keyword: contour line

Theme_Keyword: digital contours

Place:

Place_Keyword_Thesaurus:

U.S. Department of Commerce, 1977, Countries, dependencies, areas of special sovereignty, and their principal administrative divisions

(Federal Information Processing Standard 10-3):Washington, D.C., National Institute of Standards and Technology.

Place_Keyword: US

Place_Keyword: CA

Place_Keyword: MX

Place_Keyword_Thesaurus:

U.S. Department of Commerce, 1987, Codes for the identification of the States, the District of Columbia and the outlying areas of The United States, and associated areas (Federal Information Processing Standard 5-2): Washington, D. C., National Institute of Standards and Technology.

Place_Keyword: FIPS code of State or Province

Place_Keyword_Thesaurus:

U.S. Department of Commerce, 1990, Counties and equivalent entities of The United States, its possessions, and associated areas (Federal Information Processing Standard 6-4): Washington, D.C. National Institute of Standards and Technology.

Place_Keyword: FIPS code for county or counties.

Access_Constraints: None

Use_Constraints:

None. Acknowledgement of the U.S. Geological Survey would be appreciated in products derived from these data.

Data Quality Information

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

The accuracy of a DEM is dependent upon the level of detail of the source and the grid spacing used to sample that source. The primary limiting factor for the level of detail of the source is the scale of the source materials. The proper selection of grid spacing determines the level of content that may be extracted from a given source during digitization.

Logical_Consistency_Report:

The fidelity of the relationships encoded in the data structure of the DEM are automatically verified using a USGS software program upon completion of the data production cycle. The test verifies full compliance to the DEM specification.

Completeness_Report:

The DEM is visually inspected for completeness on a DEM view and edit system for the purpose of performing a final quality control and if necessary edit of the DEM. The physical format of each digital elevation model is validated for content completeness and logical consistency during production quality control and prior to archiving in the National Digital Cartographic Data Base.

Due to the variable orientation of the quadrilateral in relation to the Universal Transverse Mercator (UTM) projection grid, profiles that pass within the bounds of the DEM quadrilateral, may be void of elevation grid points, and are not represented in the DEM. This condition occurs infrequently and is always the first or last profile of the dataset.

Level 2 DEM: Level 2 DEM's may contain void areas due to interruptions to contours in the source graphic or DLG. Void area elevation grid posts are assigned the value of -32,767. In addition, suspect elevation areas may exist in the DEM but are

not specifically identified. Suspect areas can be located on the source graphic as a "disturbed surface, " symbolized by contours overprinted with photorevised or other surface patterns.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

The horizontal accuracy of the DEM is expressed as an estimated root mean square error (RMSE). The estimate of the RMSE is based upon horizontal accuracy tests of the DEM source materials which are selected as equal to or less than intended horizontal RMSE error of the DEM. The testing of horizontal accuracy of the source materials is accomplished by comparing the planimetric (X and Y) coordinates of well-defined ground points with the coordinates of the same points as determined from a source of higher accuracy.

Vertical_Positional_Accuracy:

Vertical_Positional_Accuracy_Report:

The vertical RMSE statistic is used to describe the vertical accuracy of a DEM, encompassing both random and systematic errors introduced during production of the data. The RMSE is encoded in element number 5 of record C of the DEM. Accuracy is computed by a comparison of linear interpolated elevations in the DEM with corresponding known elevations. Test points are well distributed, representative of the terrain, and have true elevations with accuracies well within the DEM accuracy criteria. Acceptable test points include, in order of preference: field control, aerotriangulated test points, spot elevations, or points on contours from existing source maps with appropriate contour interval. A minimum of 28 test points per DEM is required to compute the RMSE, which is composed of a single test using 20 interior points and 8 edge points. Edge points are those which are located along, at, or near the quadrangle neatlines and are deemed by the editor to be useful to evaluating the accuracy of the edge of the DEM. Collection of test point data and comparison of the DEM with the quadrangle hypsography are conducted by the quality control units within the USGS.

There are three types of DEM vertical errors; blunder, systematic and random. These errors are reduced in magnitude by editing but cannot be completely eliminated. Blunder errors are those errors of major proportions and are easily identified and removed during interactive editing. Systematic errors are those errors that follow some fixed pattern and are introduced by data collection procedures and systems. These error artifacts include: vertical elevation shifts,

misinterpretation of terrain surface due to trees, buildings and shadows, and fictitious ridges, tops, benches or striations. Random errors result from unknown or accidental causes.

DEM's are edited to correctly depict elevation surfaces that correspond to water bodies of specified size.

Level 1 DEM: A RMSE of 7-meters or less is the desired accuracy standard. A RMSE of 15-meters is the maximum permitted. A 7.5-minute DEM at this level has an absolute elevation error tolerance of 50 meters (approximately three times the 15-meter RMSE) for blunder errors for any grid node when compared to the true elevation. Any array of points in the DEM can not encompass more than 49 contiguous elevations in error by more than 21 meters (three times the 7-meter RMSE). Systematic errors that are within stated accuracy standards are tolerated.

Level 2 DEM: A vertical RMSE of one-half of the contour interval, determined by the source map, is the maximum permitted. Systematic errors may not exceed one contour interval, determined by the source map, is the maximum permitted. Systematic errors may not exceed one contour interval specified by the source graphic. Level 2 DEMs have been processed or smoothed for consistency and edited to remove identifiable systematic errors.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: Unknown

Title: digital contour lines

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Type_of_Source_Media: magnetic tape

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 19790701

Ending_Date: Present

Source_Currentness_Reference: ground condition

Source_Citation_Abbreviation: CONTOUR1

Source_Contribution:

hypographic vector information which is interpolated to regular grid posts to form DEM grids in 30- by 30- meter UTM data spacing within the 7.5 minute DEM bounds.

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: Unknown

Title: photo ID number

Geospatial_Data_Presentation_Form: remote-sensing image

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Type_of_Source_Media: transparency

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown

Ending_Date: Present

Source_Currentness_Reference: ground condition

Source_Citation_Abbreviation: PHOTO1

Source_Contribution: elevation values

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: Unknown

Title: project control

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Type_of_Source_Media: magnetic tape

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: Unknown

Ending_Date: Present

Source_Currentness_Reference: ground condition

Source_Citation_Abbreviation: CONTROL1

Source_Contribution: ground control points

Process_Step:

Process_Description:

The production procedures, instrumentation, hardware and software used in the collection of standard U. S. Geological Survey (USGS) Digital Elevation Models (DEM's) vary depending on systems used at the contractor, cooperator or National Mapping Division (NMD) production sites. This process step describes, in general, the process used in the production of standard USGS DEM datasets.

Level 1 DEM: Level 1 DEM's are acquired photogrammetrically by manual profiling or image correlation techniques from National Aerial Photography Program (NAPP) or equivalent source photographs. Level 1 30-minute DEM's may be derived or resampled from level 1 7.5-

minute DEM's.

Level 2 DEM: Level 2 DEM's are produced by converting 1:24,000-scale and 1:100,000-scale hypsography digital line graph (DLG) data to DEM format or the DEM's are generated from vector data derived from scanned raster files of USGS 1:24,000-scale or 1:100,000-scale map series contour separates.

Level 3 DEM: Level 3 DEM's are created from DLG data that has been vertically integrated with all categories of hypsography, hydrography, ridge line, break line, drain files and all vertical and horizontal control networks. The production of level 3 DEMs requires a system of logic incorporated into the software interpolation algorithms that clearly differentiates and correctly interpolates between the various types of terrain, data densities and data distribution.

Water body editing: DEM surface areas corresponding to water bodies are flattened and assigned map specified or estimated surface elevations. Water body areas are defined as ponds, lakes, and reservoirs that exceed 0.5 inches at map scale and double line drainage that exceeds 0.25 inches at map scale. Water body shorelines are derived either from a hypsographic DLG or by interactive delineation from 1:24,000-scale or 1:100,000-scale USGS map series.

Edge matching: DEM datasets within a project area (consisting of a number of adjacent files) are edge matched to assure terrain surface continuity between files. Edge matching is the process of correcting adjacent elevation values along common edges. The objective of edge matching is to create more accurate terrain representations by correcting the alignment of ridges and drains, and overall topographic shaping within an approximately 25-30 row or column grid post zone on both edges.

Quality control: DEM's are viewed on interactive editing systems to identify and correct blunder and systematic errors. DEM's are verified for physical format and logical consistency at the production centers and before archiving in the National Digital Cartographic Data Base (NDCDB) utilizing the Digital Elevation Model Verification System (DVS) software.

Source_Used_Citation_Abbreviation: CONTOUR1, PHOTO1, CONTROL1

Process_Date: Unknown

Process_Step:

Process_Description:

I&M Process: USGS DEM is imported into ArcInfo and the DEM is projected to the NAD83 datum.

Process_Date: Unknown

Spatial Data Organization Information

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: raster

Raster_Object_Information:

Raster_Object_Type: grid cell

Spatial Reference Information

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

Universal_Transverse_Mercator:

UTM_Zone_Number: 10-19

Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996

Longitude_of_Central_Meridian: -123 00 00

Latitude_of_Projection_Origin: 0.0

False_Easting: 500000

False_Northing: 0.0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: row and column

Coordinate_Representation:

Abscissa_Resolution: 30

Ordinate_Resolution: 30

Planar_Distance_Units: meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum 1983

Ellipsoid_Name: GRS 80

Semi-major_Axis: 6378206.4

Denominator_of_Flattening_Ratio: 294.9787

Vertical_Coordinate_System_Definition:

Altitude_System_Definition:

Altitude_Datum_Name: National Geodetic Vertical Datum of 1929

Altitude_Resolution: 1

Altitude_Distance_Units: feet or meters

Altitude_Encoding_Method: explicit elevation coordinate included with horizontal coordinates

Entity and Attribute Information

Entity_and_Attribute_Information:

Overview_Description:

Entity_and_Attribute_Overview:

The digital elevation model is composed of a 6-character integer raster representing a gridded form of a topographic map hypsography overlay. Each raster entity contains a 6-character integer value between -32,767 to 32,768.

Entity_and_Attribute_Detail_Citation:

U.S.Department of the Interior, U.S. Geological Survey,
Digital Elevation Models -- Data Users Guide; Reston, VA,

A hypertext extract is available at:

URL: http://edcwww.cr.usgs.gov/glis/hyper/guide/usgs_dem

Softcopies in ASCII and WordPerfect format are available at:

URL: <ftp://mapping.usgs.gov/pub/ti/DEM/>

U.S. Department of the Interior, U.S. Geological Survey, 1992,
Standards for digital elevation models: Reston, VA,

Softcopies in ASCII and WordPerfect format are available at:

URL: <ftp://mapping.usgs.gov/pub/ti/DEM/>

Distribution Information

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: Earth Science Information Center, U.S. Geological
Survey

Contact_Address:

Address_Type: mailing address

Address: 507 National Center

City: Reston

State_or_Province: Virginia

Postal_Code: 20192

Contact_Voice_Telephone: 1-888-ASK-USGS

Hours_of_Service: 0800-1600

Contact_Instructions:

In addition to the address above there are other ESIC offices
throughout the country. A full list of these offices is at:

URL: http://mapping.usgs.gov/esic/esic_index.html

Resource_Description: 7.5-minute digital elevation models

Distribution_Liability:

Although these data have been processed successfully on a
computer system at the U.S. Geological Survey, no warranty
expressed or implied is made by the Geological Survey
regarding the utility of the data on any other system, nor shall
the act of distribution constitute any such warranty. USGS will
warrant the delivery of this product in computer-readable
format. and will offer appropriate adjustment of credit when
the product is determined unreadable by correctly adjusted
computer input peripherals, or when the physical medium is
delivered in damaged condition. Requests for adjustments of
credit must be made within 90 days from the date of this
shipment from the ordering site.

Standard_Order_Process:

Digital_Form:

Digital_Transfer_Information:

Format_Name: DEM

Format_Information_Content:

USGS standard DEM: The standard USGS

DEM can be described as an ASCII formatted

elevation file preceded by a metadata header file which consists of one 1024 byte ASCII record.

Transfer_Size: 1

Digital_Transfer_Option:

Offline_Option:

Offline_Media: CD-ROM

Recording_Capacity:

Recording_Density: 680000

Recording_Density_Units: megabytes

Recording_Format: ISO 9660

Compatibility_Information:

This CD-ROM can be used with all computer operating systems that support CD-ROM as a logical storage device. All text files on the disc are in ASCII format. Data files are in ASCII or binary format.

Offline_Option:

Offline_Media: Cartridge

Recording_Capacity:

Recording_Density: 3480

Recording_Density_Units: megabytes

Recording_Format:

ASCII; available unlabelled or with ANSI-standard labels; available block sizes are multiples of 1024 characters. To ensure compatibility, a maximum blocking factor of 31744 is recommended. For efficiency, blocking factors less than 16,000 are discouraged.

Offline_Option:

Offline_Media: Cassette

Recording_Capacity:

Recording_Density: 8-mm High (4.5Gb)

Recording_Density_Units: gigabytes

Recording_Format:

ASCII; available unlabelled or with ANSI-standard labels; available block sizes are multiples of 1024 characters. To ensure compatibility, a maximum blocking factor of 31744 is recommended. For efficiency, blocking factors less than 16,000 are discouraged.

Offline_Option:

Offline_Media: Cassette

Recording_Capacity:

Recording_Density: 8-mm Low (2.3Gb)

Recording_Density_Units: gigabytes

Recording_Format:

ASCII; available unlabelled or with ANSI-standard labels; available block sizes are multiples of 1024 characters. To ensure compatibility, a maximum blocking factor of 31744 is recommended. For efficiency, blocking factors less than 16,000 are discouraged.

Fees:

The online copy of the data set (when available electronically) may be accessed without charge. For cartridge, cassette, and CD-ROM the costs are available at:

URL: http://edcwww.cr.usgs.gov/glis/hyper/order_info/prices#7_MIN_DEM

Ordering_Instructions:

Dataset searching and ordering capabilities are available through the Global Land Information System (GLIS) at:

URL: <http://edcwww.cr.usgs.gov/webglis>

Metadata Reference Information

Metadata_Reference_Information:

Metadata_Date: 199501

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: U.S. Geological Survey

Contact_Address:

Address_Type: mailing address

Address: 508 National Center

City: Reston

State_or_Province: VA

Postal_Code: 20192

Contact_Voice_Telephone: 703 648 4543

Metadata_Standard_Name: Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: 19940608

Metadata_Security_Information:

Metadata_Security_Classification_System: None

Metadata_Security_Classification: Unclassified

Metadata_Security_Handling_Description: None